

Environmental profile of green roof material in different locations in Spain: Life Cycle Assessment and optimisation.

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1. Introduction

The building construction industry consumes 40% of the materials entering the global economy and generates 40–50% of the global output of greenhouse gases and agents of acid rain. Thus, energy building consumption minimization became one of the basic principles of the European Environmental Legislation and Strategy. [1]

Considering this, the benefits provided by green roofs appear to make them a good option. They reduce thermal fluctuation on the outer roof surface and increase thermal capacity; help to mitigate air pollution; reduce urban heat island effect and noise propagation; reduce runoff peaks of rainfall events; and increase biodiversity. [2-5]

The use of green roofs has increased noticeably in recent years in many countries, but relevant up-to-date environmental data is needed to allow the environmental comparison of green roofs with conventional solutions. This will help us to assess their behaviour and analyse if, just because they have vegetation, we can call them “ecological roofs”.

There are examples of Life Cycle Assessment (LCA) studies of some construction materials, however no comprehensive Life Cycle Inventory (LCI) data for green roofs is available in the literature. The scope of the study is to deepen the knowledge of green roofs by studying the environmental profile of the materials used to build them, and how their adaptation to climatic conditions affects their environmental impact. To do so, LCA methodology has been used to study the environmental profile of the materials.

2. Materials and methods

The composition of the roof and the characterisation of the materials have been analysed in different locations in Spain. Figure 1 displays the description of the roof. The functional unit chosen is 1m² of green roof and the insulation of the roof has been adapted to the needs of the locations.

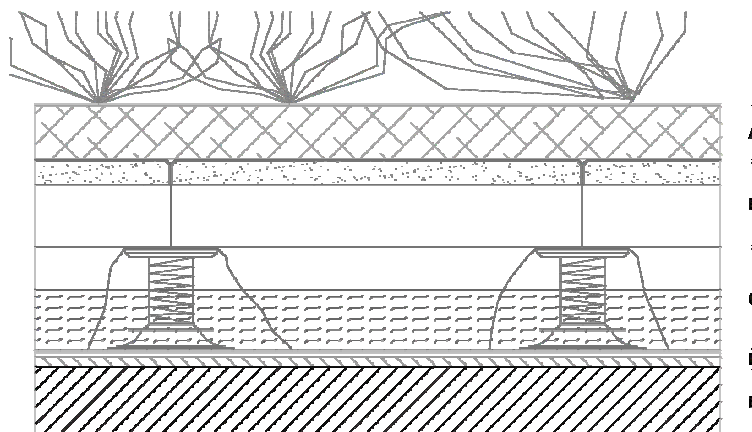


Figure 1: Description of the studied green roof. A: Surface finish; B: Insulation; C: Water basin; D: Waterproofing; E: Structure.

Both Ecoindicator 99 and CML 2000 methodologies have been used to detect the critical elements of the system.

3. Results and discussion

The characterisation results obtained with CML 2000 (Figure show that the structure is responsible for the largest contribution in all the impact categories. This is due to the cement fabrication process, which produces high levels of emissions and energy consumption. The figure shows the results of the configuration in Madrid.

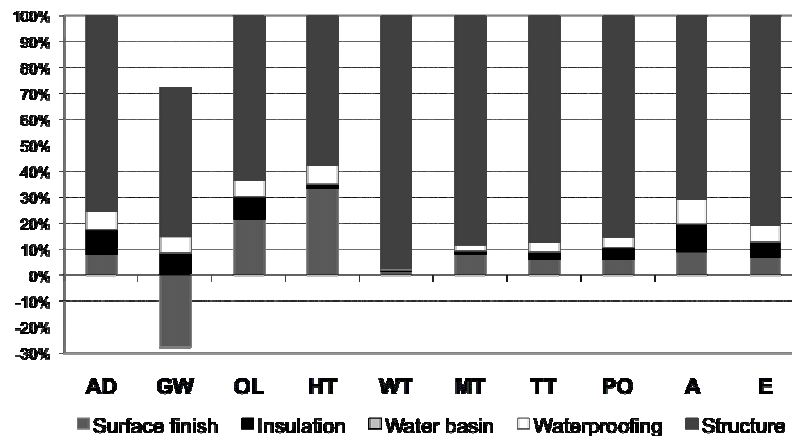


Figure 2: Characterisation results of the CML 2000 in Madrid. AD: Abiotic depletion; GW: Global warming; OL: Ozone layer depletion; HT: Human toxicity; WT: Fresh water aquatic ecotoxicity; MT: Marine aquatic ecotoxicity; TT: Terrestrial ecotoxicity; PO: Photochemical oxidation; A: Acidification; E: Eutrophication.

The normalisation was done with both E 99 and CML 2000 methodologies. The structure can be regarded as the common element in every roof. Therefore, it was removed in order to detect the crucial points and to be able to compare different configurations of roofs.

It can be observed that the manufacturing of the polyester is the most relevant process in the surface finish layer.

Sensitivity analysis shows that there are no distinguishable differences between the distinct locations.

4. Conclusions

The environmental impact of the materials that formed the green roof has been analysed in order to detect critical points and to make a sensitivity analysis between different locations. It has been found that the effect of the insulation layer is not significant from an environmental point of view. The surface layer creates the most impact, when the structure is not considered.

The energy performance is currently being evaluated in order to make the comparison with other roof configurations possible, and to be prove whether these roofs are only green or rather are truly “ecological roofs”.

5. References

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